Proactively Manage Your Milk Fat

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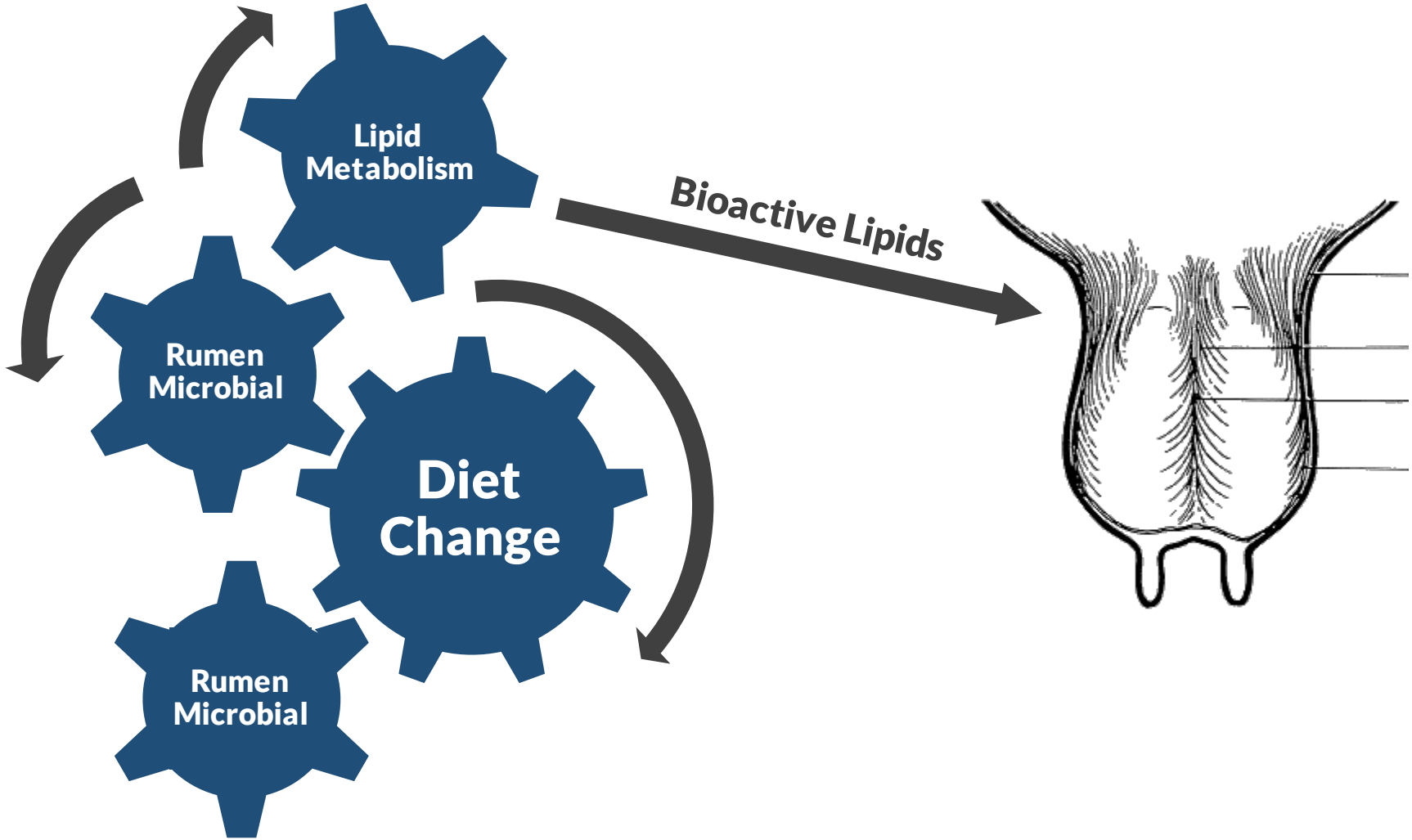
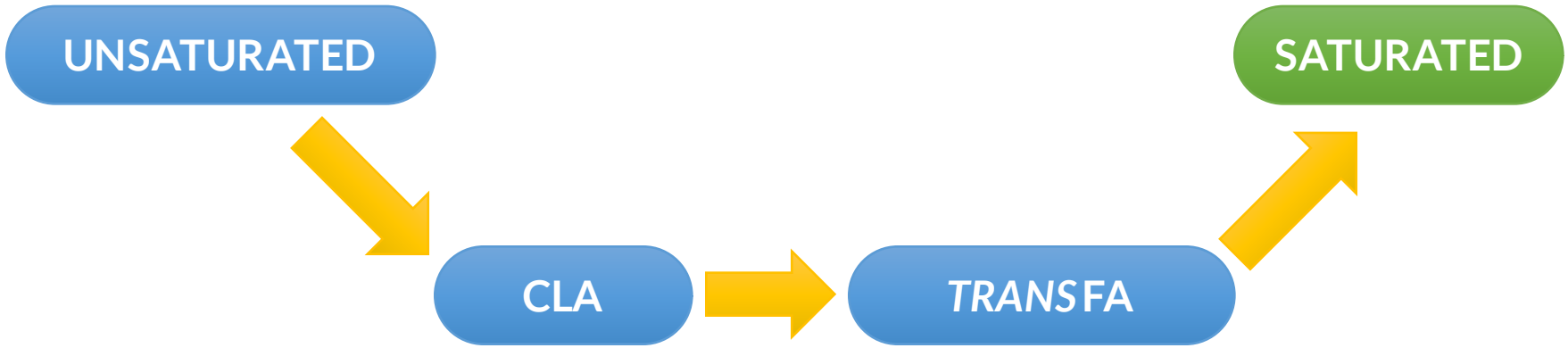
Machinery of Diet-Induced MFD

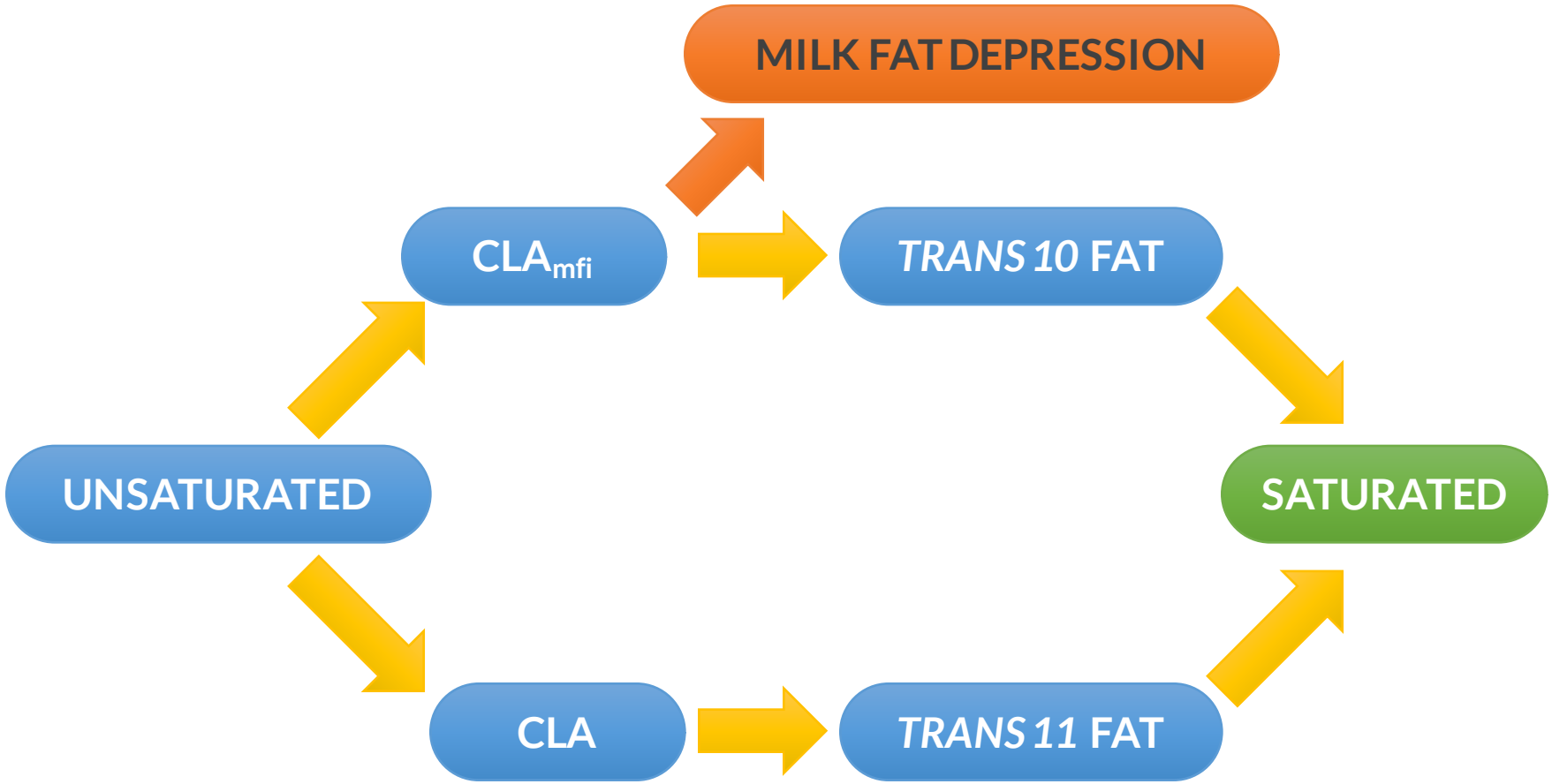


Source of Bioactive Lipids

Intermediates of Biohydrogenation



CLA Shift



From Jenkins and Harvatine (2014) Vet. Clin. Food Anim. 30:623-642.

CLA Tested

- trans-8, cis-10 CLA
- cis-9, trans-11 CLA
- trans-9, trans-11 CLA
- trans-10, trans-12 CLA
- cis-11, trans-13 CLA
- trans-9, cis-11 CLA (Perfield et al. 2007)
- trans-10, cis-12 CLA (Baumgard et al. 2000)
- cis-10, trans-12 CLA (Saebo et al. 2005)

c9t11 CLA No MFD

t10c12 CLA Causes MFD

Dietary Changes That Affect CLA_{mfi}

- Main drivers of MFD
  - Too much of the wrong type of fat
  - Too much starch
  - Low rumen pH
- Fine tuning of MFD
  - Potassium carbonate (+)
  - Palmitate (+)
  - Yeast/Molds (-)
  - Ionophores (-)

How much fat is too much?

3.4% Added Soybean Oil

	CON	SBO
TMR EE, % DM	3.3	4.9
Milk, kg/d	27.5	29.4
Milk fat, kg/d	1.03	0.92*
Milk fat, %	3.76	3.14*

*CON and FAT diets differed ($P < 0.05$).
Taken from AlZahal et al., 2008. J. Dairy Sci. 91:1166–1174.

3.6% Added CaFA

	CON	CaFA
TMR FA, % DM	2.94	6.23
Milk, kg/d	90.9	92.4
Fat, %	3.59[a]	3.89[b]

[ab] Means with different superscripts within a row differ.
Taken from Weiss et al. 2011. J. Dairy Sci. 94 :931–939

3.5% Added Fatty Acids on 24 h Rumen In Vitro

	Control	Stearic	Oleic	Linoleic	Linolenic
Ac/Pr	5.27^{a}	4.87^{a}	4.13^{b}	2.90^{c}	2.08^{d}
F. succinogenes	2.04^{c}	2.69^{a}	2.26^{b}	1.37^{d}	1.13^{e}
Methane, mmol	1.03^{a}	0.99^{ab}	0.94^{b}	0.75^{c}	0.56^{d}
Protozoa	2.99^{a}	2.26^{b}	1.96^{c}	1.80^{c}	1.30^{c}

^{abc} Means with different superscripts within a row differ ($P < 0.05$).
Zhang et al. (2008) Anim. Feed sci. Tech. 146:256–269.

RUFAL

Rumen Unsaturated Fatty Acid Load (RUFAL)

18:1 (oleic)

+ 18:2 (linoleic)

+ 18:3 (linolenic)

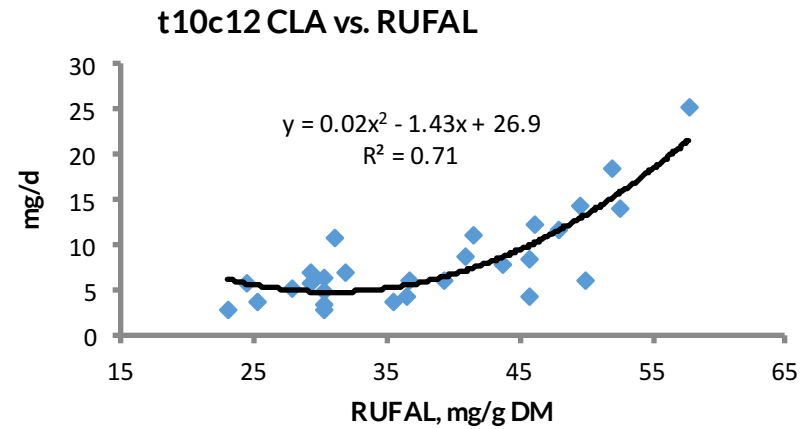
A Way to Monitor The High Risk Fatty Acids

Rumen Unsaturated FA Load (RUFAL)

Dry Matter: 54.2%
Moisture: 45.8%

	As Sampled %	Dry Matter Basis %
Fat (ether extract)	N/A	N/A
Fat (acid hydrolysis)	N/A	N/A
Total Fatty Acid	3.00	5.54

		Relative Basis %	Dry Matter Sample Basis %
C12:0	Lauric Acid	0.09	0.01
C14:0	Myristic Acid	0.68	0.04
C16:0	Palmitic Acid	23.47	1.30
C16:1	Palmitoleic Acid	0.47	0.03
C18:0	Stearic Acid	2.84	0.16
C18:1	Oleic Acid	25.06	1.39
C18:2	Linoleic Acid	41.90	2.32
C18:3	Linolenic Acid	4.03	0.22
C20:0	Arachidic Acid	0.53	0.03
C20:1	11-Eicosenoic Acid	0.16	0.01
C20:2	11-14 Eicosadienoic Acid	N/D	N/D
C22:0	Behenic Acid	0.38	0.02
C22:1	Erucic Acid	N/D	N/D
C24:0	Lignoceric Acid	0.42	0.02
C24:1	Nervonic Acid	N/D	N/D
Total		100.0	5.54

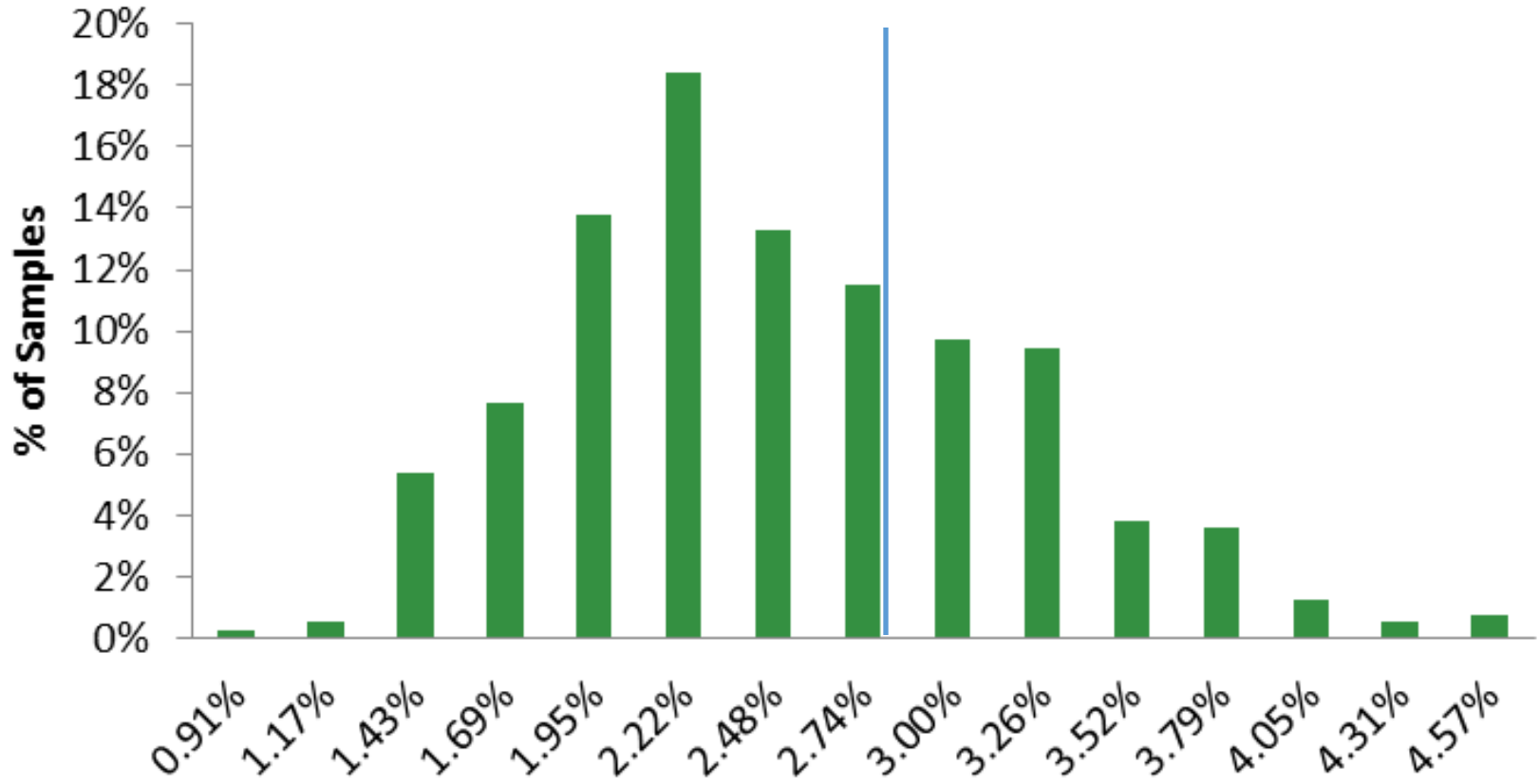


Sun, Jenkins, & Lock.2013 ADSA Abstract #656

3.9

>3% Higher Risk
<3% Lower Risk

18:1+18:2+18:3 Fatty Acid % DM



Courtesy of Kyle Taysom
Business Development Manager
Dairyland Laboratories, Inc. n=397

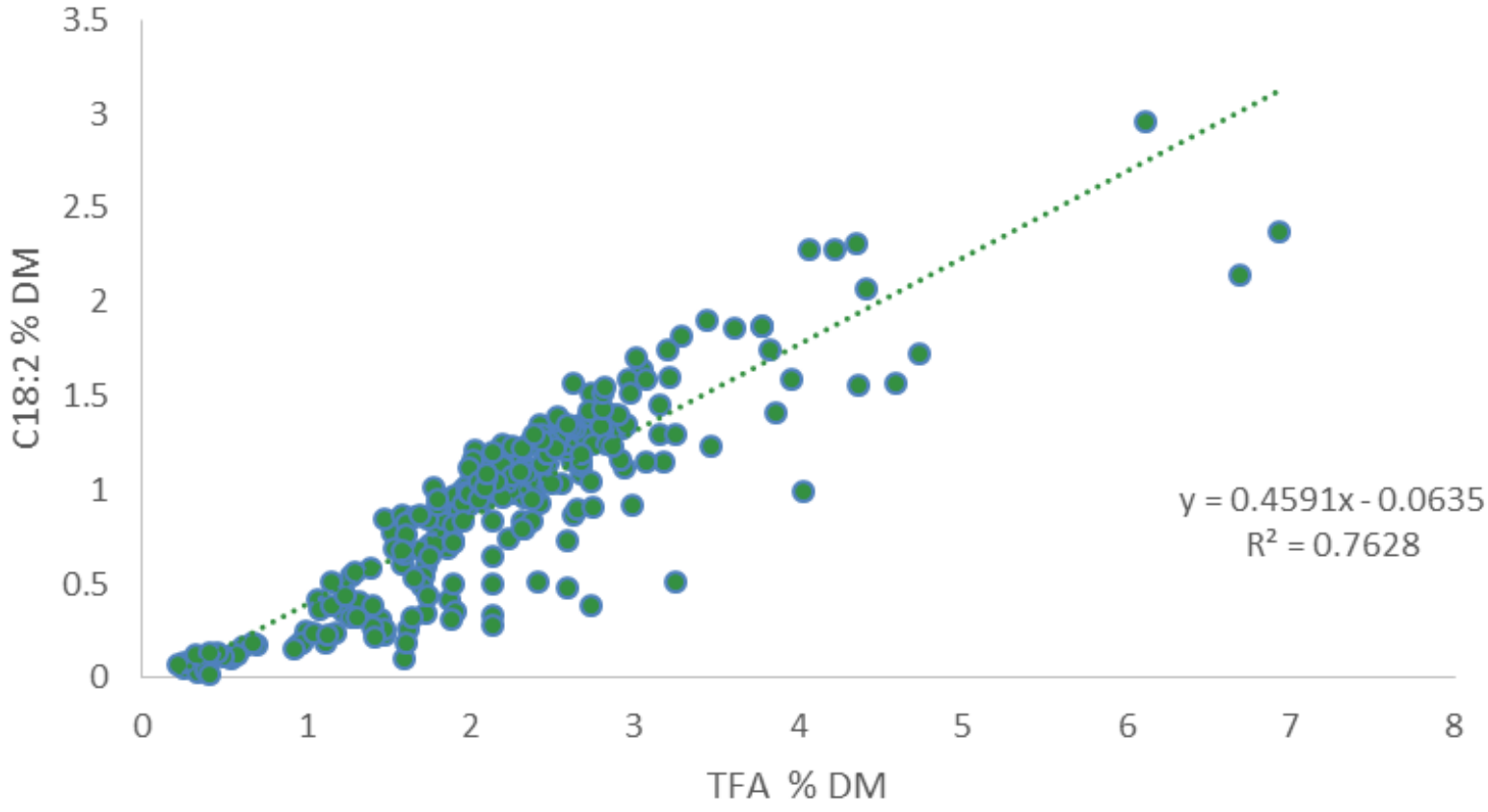
Fatty Acid Sources

Ingredient	DMI, lb./d	RUFAL, g/d
Corn Silage, Med Chopped	21.95	
Alfalfa Hay	5.78	
Gorn Grain	9.34	
Citrus Pulp	1.03	
Cottonseed	2.30	
Megalac	0.29	
Soybean Meal	6.95	
Other (min/vit, trace supp.)	1.32	
Total	48.96	573
RUFAL, % DM		2.57

Fatty Acid Sources

Ingredient	DMI, lb./d	RUFAL, g/d
Corn Silage, Med Chopped	21.95	152
Alfalfa Hay	5.78	26
Gorn Grain	9.34	139
Citrus Pulp	1.03	6
Cottonseed	2.30	142
Megalac	0.29	48
Soybean Meal	6.95	60
Other (min/vit, trace supp.)	1.32	0
Total	48.96	573
RUFAL, % DM		2.57

Corn Silage



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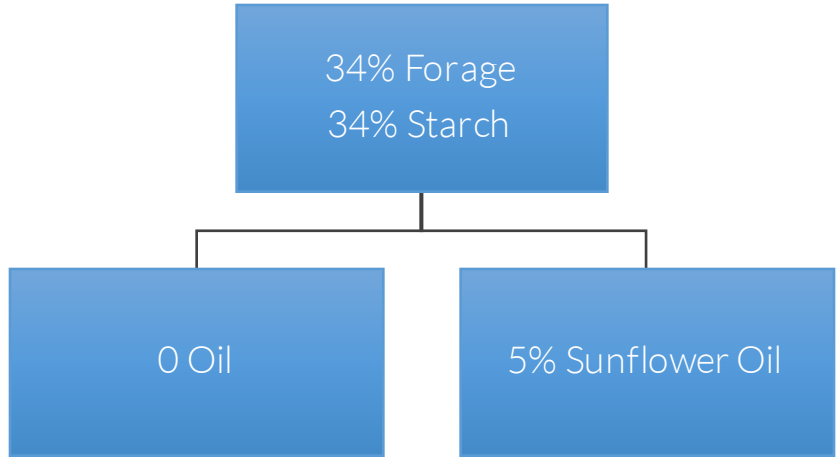
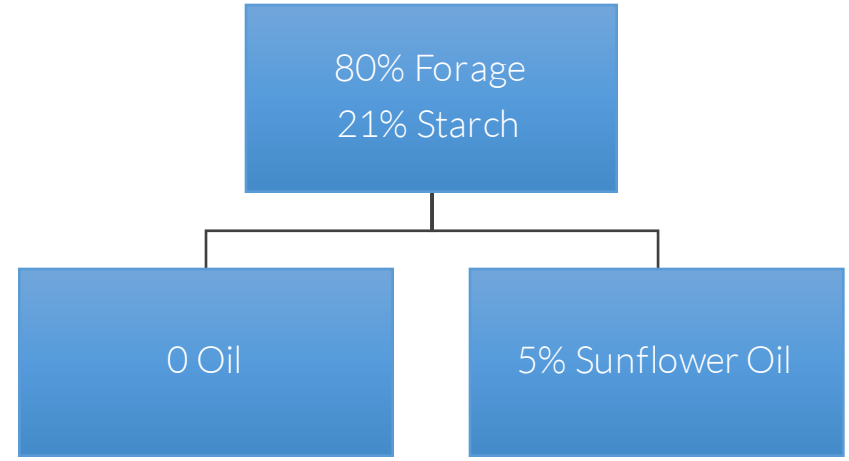
Laboratories, Inc.

%DM	18:2	TFA
Average	0.95	2.21
Normal Min	0.02	0.34
Normal Max	1.93	4.08

Ingredient	1.5% CS	3.5% CS
Corn Silage, Med Chopped	152	349
Alfalfa Hay	26	26
Gorn Grain	139	139
Citrus Pulp	6	6
Cottonseed	142	142
Megalac	48	48
Soybean Meal	60	60
Other (min/vit, trace supp.)	0	0
Total	573	770
RUFAL, % DM	2.57	3.47

Forage/Concentrate Interactions

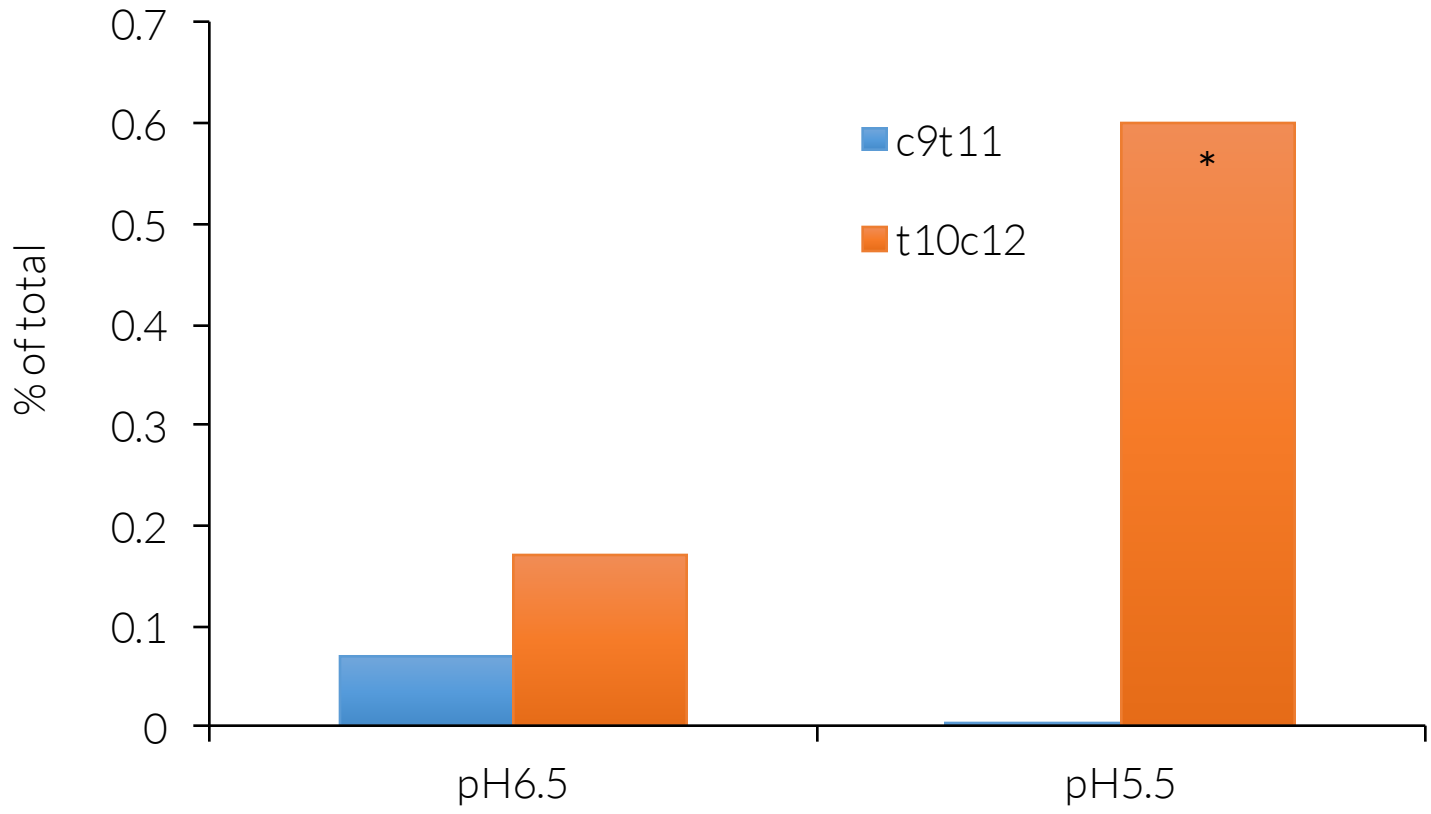




RUFAL, % DM	1.2	4.8	1.2	4.8
t10c12 CLA, %	17.8	53.1	5.3	2.8

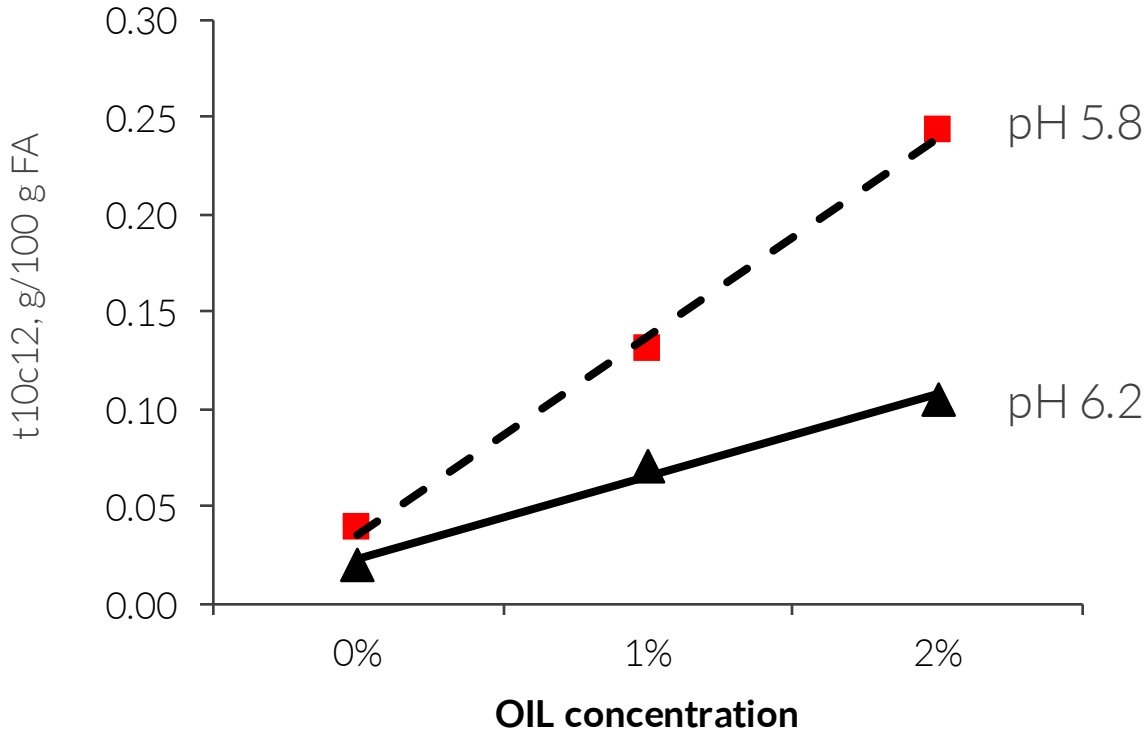
From Zened et al. 2013. JDS 96:451-459.

CLA Production vs. pH



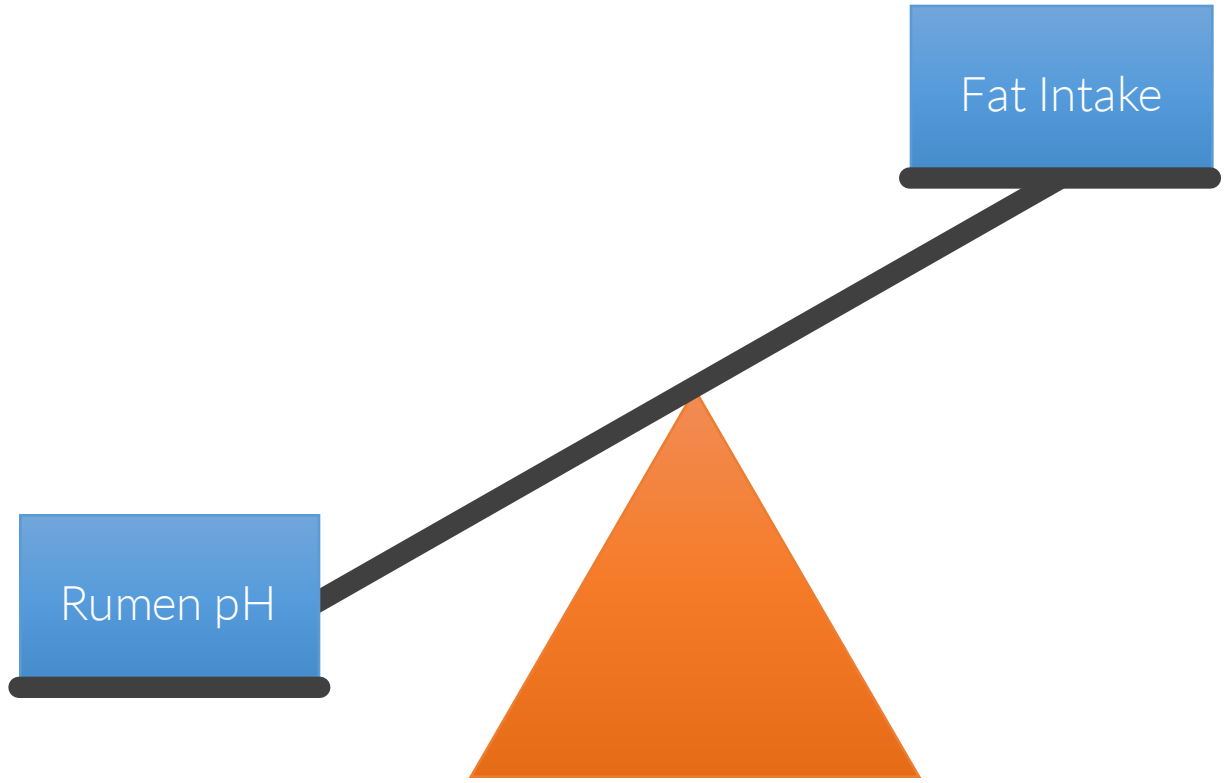
Continuous culture data taken from Fuentes et al, 2009.

pH & Corn Oil Interactions



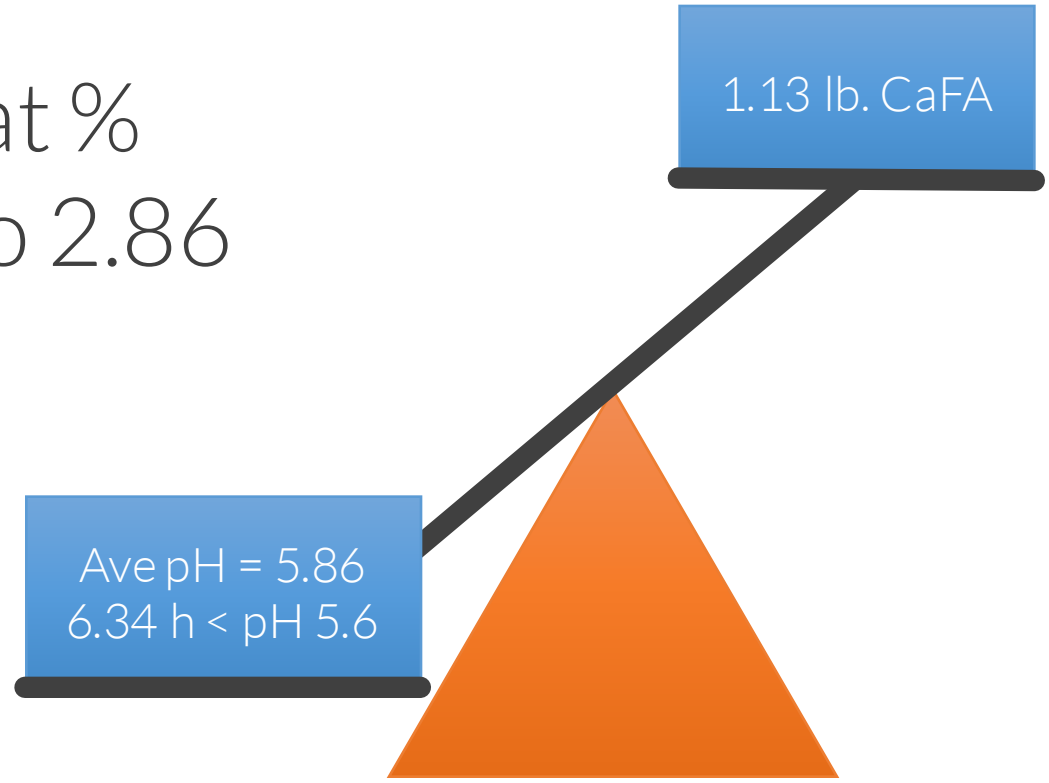
Sun et al. 2014. J. Dairy Sci. 97 (E-Suppl. 1): 319. Slide courtesy of Dr. Adam Lock

How Do You Manage MFD?



How Do You Manage MFD?

Milk fat %
3.14 to 2.86



Rico et al. 2014.

47.5 lb basal @ 1.8% FA = 0.85 lb
+ 2.2 lb soybean oil (2 lb FA)

$$\text{Max lbs} = \frac{4^{*}\text{NDF}^{*}\text{DMI}}{(\text{UFA}^{*}\text{FA})_{\text{fat}}}$$

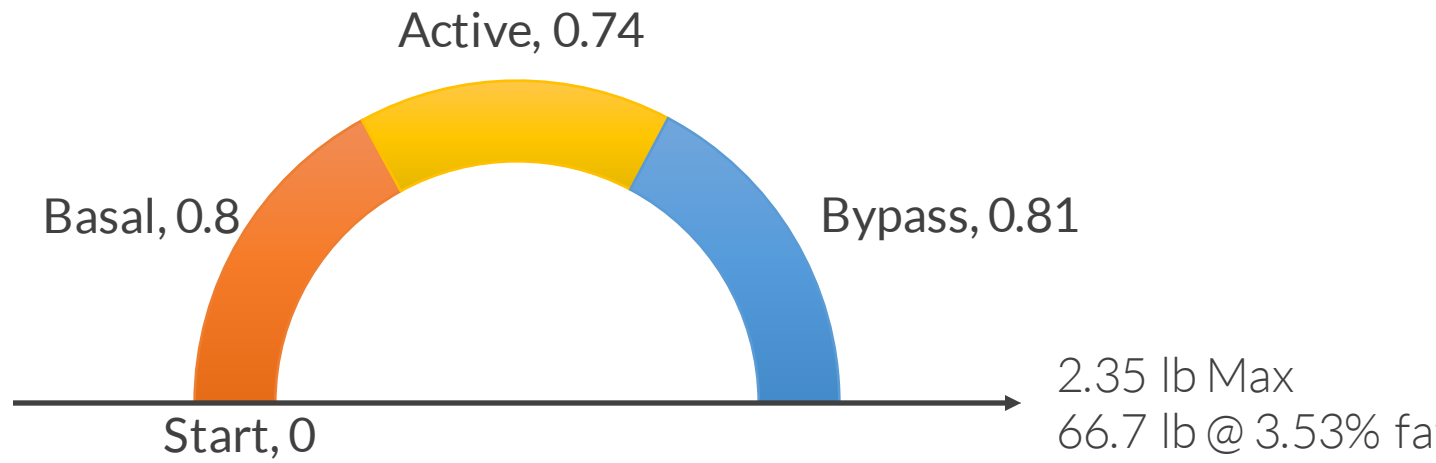
0.8 lb Soybean oil
0.74 lb FA

2.35 lb Max
66.7 lb @ 3.53% fat

Milk fat % 3.59 to 2.62

Huang et al. 2008.

0.81 lb. bypass
0.81 lb. (100 % FA)
0.95 lb. (85% FA)

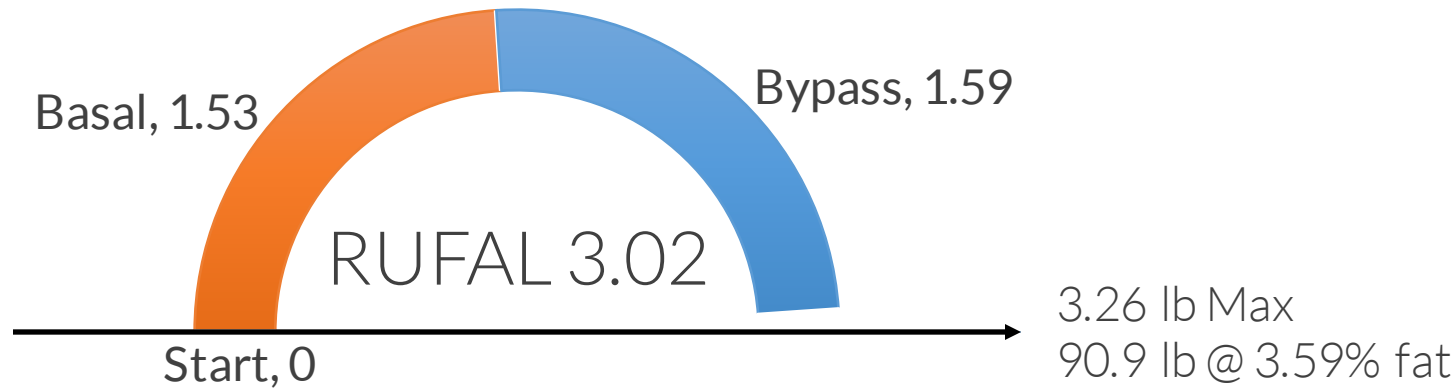


Milk fat % 3.59 to 2.62

Huang et al. 2008.

51.9 lb basal @ 2.94% FA = 1.53 lb
+ 1.87 lb CaFA (1.59 lb FA)

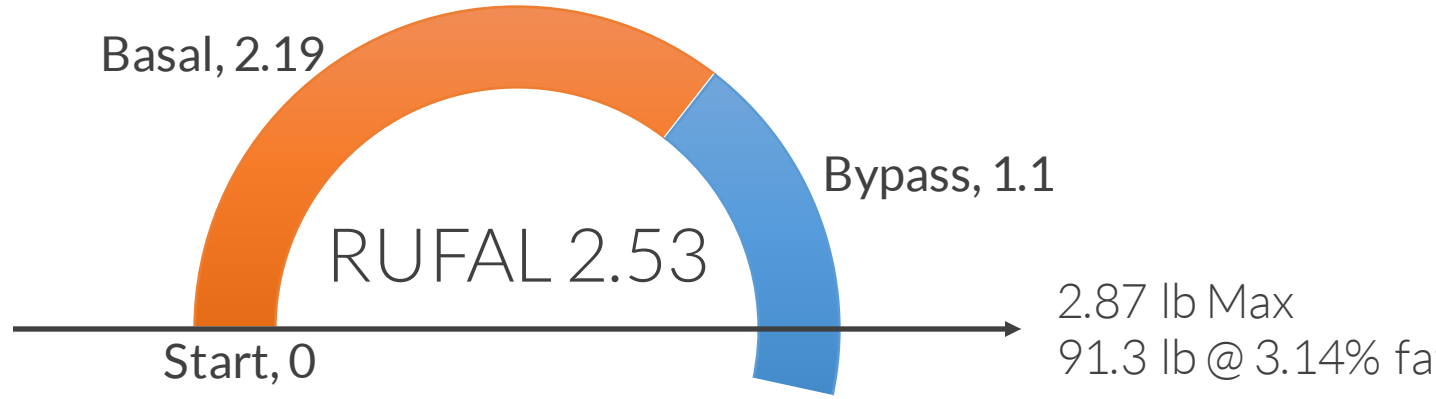
Max lbs = $\frac{4*NDF*DMI}{(UFA*FA)_{fat}}$
7.8 lb DDG
0.78 lb FA



Milk fat % 3.59 to 3.89

Weiss et al. 2011.

57.6 lb basal @ 3.8% FA = 2.19 lb
+ 1.1 lb PA (1.1 lb FA)



Milk fat % 3.14 to 3.22

Rico et al. 2014.

Manage Rumen pH

- Effective fiber
  - Particle Length (Cornell Epi)
    - Bottom Pan of Penn State Shaker Box <54%
    - > 49% on middle screen
    - Top screen didn't matter
- Starch (7h K_d < 85%)
- Buffers
- Management
  - TMR mixing
  - Feeding frequency
  - Crowding

Fine tuning!

Palmitate (C16)[1] Effects on Milk Fat

	Milk Fat, %		Study Length	Cows	
g Added C16	–C16	+C16	Days	Number	Reference
384	3.75	3.60*	35	214	Warntges et al., 2008
449	3.14	3.22	14	24	Rico and Harvatine, 2011
412	3.44	3.93*	16	18	Mosley et al. 2012
361	3.88	4.16*	25	16	Lock et al., 2013
545	3.29	3.40*	21	32	Piantoni et al, 2013

[1]All supplemented sources were > 85% C16.

Palmitic Acid

- Good Points
  - Same energy as other bypass fats
  - Research results more often than not show increased milk fat (0.1 to 0.3 % units)
- Questions
  - Responses over longer time?
  - Responses in studies with more cows?
  - Responses when comparing to other bypass fats?

K Carbonate[1] Effects on Milk Fat

	Milk Fat, %			
Δ TMR K	**- K**	**+ K**	**P <**	**Reference**
1.2 to 2.0%	4.01	4.38	0.05	Harrison et al. 2012
1.2 to 2.2 % (LF)	2.74	2.99	0.05	Kamar and Weiss, 2013
1.2 to 2.2 % (HF)	2.39	2.64	0.05	Kamar and Weiss, 2013
1.8 to 2.3%	4.06	4.28	0.05	Ma et al., 2013

[1]Added as K carbonate sesquihydrate (DCAD Plus, C&D, Inc.)

CLA production from continuous culture.

	Treatment			
mg/d	CON	K_2CO_3	Na_2CO_3	SE
Total CLA	28.1	23.7	26.5	4.1
c9t11[a]	8.4	11.4	12.6	1.2
t10c12[b]	19.7	12.4	14.0	3.6

[a] CON differed from others ($P < 0.05$)
[b] CON differed from others ($P < 0.10$)

Young et al. 2015. ADSA Poster T396.

Points to Remember

- CLA_{MFI} overproduction in the rumen leads to MFD.
- Feeding management controls MFD by limiting accumulation of CLA_{MFI} in the rumen.
- No single dietary factor is responsible for MFD.
  - ❑ interactions among various dietary components can increase the rumen outflow of CLA_{MFI}
- All risks have to be considered with regard to the combination of factors at play in a given ration formulation and with regard to the limitations of management and physical plant.